Article

# Reactive metal-support interactions at moderate temperature in two-dimensional niobium-carbide-supported platinum catalysts

Zhe Li, Yanran Cui, Zhenwei Wu, Cory Milligan, Lin Zhou, Garrett Mitchell, Biao Xu, Enzheng Shi, Jeffrey T. Miller, Fabio H. Ribeiro & Yue Wu

Nature Catalysis 1, 349–355 (2018) doi:10.1038/s41929-018-0067-8

Catalyst synthesis Chemical engineering

Materials for energy and catalysis

Received: 05 October 2017

Accepted: 28 March 2018

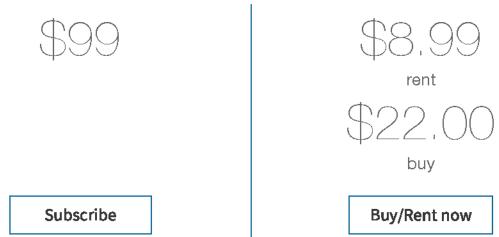
Published: 07 May 2018

## **Abstract**

The reactive metal–support interaction (RMSI) offers electronic, geometric and compositional effects that can be used to tune catalytic active sites. Generally, supports other than oxides are disregarded as candidates for RMSI. Here, we report an example of non-oxide-based RMSI between platinum and Nb<sub>2</sub>CT <sub>x</sub> MXene—a recently developed, two-dimensional metal carbide. The surface functional groups of the two-dimensional carbide can be reduced, and a Pt–Nb surface alloy is formed at a moderate temperature (350 °C). Such an alloy exhibits weaker CO adsorption than monometallic platinum. Water-gas shift reaction kinetics reveals that the RMSI stabilizes the nanoparticles and creates alloy–MXene interfaces with higher H<sub>2</sub>O activation ability compared with a non-reducible support or a bulk niobium carbide. This RMSI between platinum and the niobium MXene support can be extended to other members of the MXene family and opens new avenues for the facile design and manipulation of functional bimetallic catalysts.

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# Acknowledgements

Y.W. appreciates support from the Herbert L. Stiles Professorship and the ACRI Center Initiative at Iowa State University. F.H.R. acknowledges the partial support provided by the National Science Foundation. This paper is based on work supported in part by the National Science Foundation under cooperative agreement EEC-1647722. Any opinions, findings and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Science Foundation.

### **Author information**

These authors contributed equally: Zhe Li, Yanran Cui, Zhenwei Wu.

#### **Affiliations**

Department of Chemical and Biological Engineering, Iowa State University, Ames, IA, USA Zhe Li, Biao Xu, Enzheng Shi & Yue Wu

Charles D. Davidson School of Chemical Engineering, Purdue University, West Lafayette, IN, USA

Yanran Cui, Zhenwei Wu, Cory Milligan, Garrett Mitchell, Jeffrey T. Miller & Fabio H. Ribeiro

Department of Energy, Ames Laboratory, Ames, IA, USA Lin Zhou

#### **Contributions**

Z.L. conceived the research and performed the synthesis and material characterizations. Y.C. and F.H.R. carried out the CO chemisorption and WGS kinetics measurements. Z.W. and J.T.M. carried out the XAS measurements. L.Z., G.M., B.X. and E.S. conducted microscopy analyses. C.M. performed the XPS experiments. Y.W. supervised and led the project.

# **Competing interests**

The authors have filed a patent application (US Patent application no. 62/579,364).

## Corresponding author

Correspondence to Yue Wu.

# Supplementary information

Supplementary Information - https://static-

8/MediaObjects/41929\_2018\_67\_MOESM1\_ESM.pdf

Supplementary Methods; Supplementary Figures 1–13; Supplementary Table 1; Supplementary References

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Nature Catalysis ISSN 2520-1158 (online)

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